

CLAIMS

We claim:

- 5 1 A method for making a polymeric layer on a substrate comprising the steps of:
- a) forming a layer of a liquid comprising a photopolymerizable polymer precursor between the substrate and an at least partially transparent element;
 - b) exposing the liquid layer to light through the at least partially transparent element, thereby polymerizing one or more regions of the liquid layer to form a polymeric layer; and
 - 10 c) removing any unpolymerized region or regions of the liquid layer.
2. The method of claim 1, wherein the at least partially transparent element is a photomask, and a patterned polymeric layer is formed.
- 15 3. The method of claim 1 wherein the at least partially transparent element has three-dimensional features on the side of the element which contacts the liquid.
4. The method of claims 1 or 2, wherein the liquid further comprises a photoinitiator.
- 20 5. The method of claims 1 or 2, wherein the liquid further comprises an iniferter or an iniferter precursor.
6. The method of claim 5, wherein the liquid further comprises a photoinitiator.
- 25 7. A method for forming a composite polymeric layer on a substrate comprising the steps of:
- a) forming a first layer of a first liquid comprising a first polymer precursor between the substrate and a first at least partially transparent element, wherein the first at least partially transparent element is a photomask;
 - 30 b) exposing the first liquid layer to light through the first at least partially transparent element, thereby polymerizing at least a region of the first liquid layer to form a patterned first polymeric layer having at least one unpolymerized region;

- c) removing any unpolymerized region or regions of the first liquid layer, thereby forming at least one cavity;
- d) removing the first at least partially transparent element;
- e) filling at least one cavity of the first polymeric layer with a second liquid comprising a second polymer precursor, wherein the second polymer precursor is different from the first;
- f) placing a second at least partially transparent element in contact with the second liquid and opposite to the substrate;
- g) exposing the second liquid layer to light through the second at least partially transparent element, thereby polymerizing at least a region of the second liquid layer to form a patterned second polymeric layer; and
- h) removing any unpolymerized region or regions of the second liquid layer.

8. The method of claim 7 wherein the first liquid further comprises a photoinitiator.

9. The method of claim 7 wherein the first liquid further comprises an iniferter or an iniferter precursor.

10. A method for forming a multilayered polymeric device on a substrate comprising the steps of:

- a) forming a first layer of a first liquid comprising a first polymer precursor between the substrate and a first at least partially transparent element;
- b) exposing the first liquid layer to light through the first at least partially transparent element, thereby polymerizing at least a region of the first liquid layer to form a first polymeric layer
- c) removing any unpolymerized region or regions of the first liquid layer;
- d) removing the first at least partially transparent element;
- e) forming a second layer of a second liquid comprising a second polymer precursor at least in part between the first polymeric layer and a second at least partially transparent element;
- f) exposing the second liquid layer to light through the second at least partially transparent element, thereby polymerizing at least a region of the second liquid layer to form a second polymeric layer; and

g) removing any unpolymerized region or regions of the second liquid layer.

11. The method of claim 10 wherein at least one of the polymeric layers is a patterned polymeric layer.

12. The method of claim 10 further comprising filling one or more cavities in the first polymeric layer with a sacrificial material.

13. The method of claim 12 further comprising removing excess sacrificial material from the surface of the first polymeric layer prior to forming the layer of the second liquid.

14. The method of claim 10 wherein the first liquid further comprises an iniferter or an iniferter precursor.

15. The method of claim 10 further comprising the steps of

h) removing the previous element;

i) forming a subsequent layer of a subsequent liquid comprising a subsequent polymer precursor at least in part between the previous polymeric layer and a subsequent at least partially transparent element;

j) exposing the subsequent liquid layer to light through the subsequent at least partially transparent element, thereby polymerizing at least a region of the subsequent liquid layer to form a subsequent polymeric layer; and

k) removing any unpolymerized region or regions of the subsequent liquid layer.

16. The method of claim 15 further comprising filling one or more cavities in the previous polymeric layer with a sacrificial material before forming the layer of the subsequent liquid.

17. The method of claim 16 further comprising removing excess sacrificial material from the surface of the previous polymeric layer before forming the layer of the subsequent liquid.

18. The method of claim 15 further comprising repeating steps h through k until the desired number of polymeric layers is formed.
19. An apparatus for photolithographic fabrication of a photo-polymerized layer from a layer of a liquid comprising a photopolymerizable polymer precursor, the apparatus comprising:
- a) a source of light; and
- b) a reaction chamber for containing the liquid layer, the chamber comprising a first and a second enclosing element, the first enclosing element comprising an at least partially transparent element placed in the path of the light and contacting the liquid within the chamber, the second enclosing element of the chamber being opposite to the first enclosing element.
20. The apparatus of claim 19 wherein the second enclosing element of the chamber is substantially parallel to the first element.
21. The apparatus of claim 19 wherein the reaction chamber substantially encloses the liquid layer.
22. The apparatus of claim 19 further comprising means for adjusting the separation between the first and second enclosing elements.
23. The apparatus of claim 19 further comprising means for measuring the separation of the first and second enclosing elements of the chamber.
24. The apparatus of claim 19 further comprising means for adjusting the alignment of the first and second enclosing elements.
25. The apparatus of claim 19 further comprising means for measuring the alignment of the first and second enclosing elements.